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Three-Dimensional Simulations of National Ignition Facility Capsule Implosions

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Hydrodynamic instabilities play a crucial role in the performance of inertial confinement fusion capsule implosions. As the capsule shell accelerates inward the ablation surface is Rayleigh-Taylor (RT) unstable. A Richtmyer-Meshkov type of instability grows due to shocks passing through perturbations at all interfaces. Compression of the fuel causes the shell to decelerate, resulting in an RT instability at the fuel-pusher interface. If spikes of pusher material grow sufficiently large they will quench capsule ignition. For the National Ignition Facility (NIF) standard point design capsule the surface finishes presently attainable are expected to result in RT growth which progresses into the nonlinear regime. Since nonlinear RT instability growth occurs faster in three dimensions (3-D) than in 2-D[1], direct 3-D simulations of hydrodynamic instability evolution are of interest.

We present the first 3-D simulations of the NIF point design capsule, performed with the HYDRA radiation hydrodynamics code.[2] These examine the growth of multimode perturbations, seeded by roughness on both the inner and outer surfaces, over a portion of the capsule. Perturbations with wavelengths similar to the capsule shell thickness are generally considered to be the most dangerous to the survival of the shell. Multimode coupling between these relatively short wavelength perturbations can also drive up long wavelength modes. These can grow large due to their large saturation amplitudes. Simulations will examine the significance of multimode coupling for ignition capsule performance. In addition we will examine the effects on implosion symmetry resulting from the x-ray drive in the cylindrical hohlraum. The coupled effects of asymmetries which arise from the radiation drive and from surface perturbations will also be explored.

[1] M.M. Marinak *et al.*, Phys. Rev. Lett. **75**, 3677 (1995).
[2] Phys. of Plasmas, in press (July, 1996).

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